Claims

I claim:

1. A centrifugal blower, comprising a centrifugal fan comprising:

a hub adapted for rotation about a central axis;

a first plurality of blades arranged about the central axis, wherein each of the blades defines

a leading edge;

a trailing edge;

a first side edge extending between the leading edge and the trailing edge, the first side edge being swept from the leading edge in a direction axially away from the leading edge and radially outward toward the trailing edge;

a second side edge extending between the leading edge and the trailing edge, a portion of the second side edge integral with at least a portion of the hub, the second side edge being swept from the leading edge in a direction axially away from the leading edge and radially outward toward the trailing edge;

an inlet radius defined as an outermost radius of the blade leading edge;

a shroud integral with at least a portion of one of the first and second side edges of the first plurality of blades;

an intermediate radius defined as an innermost radius of the shroud;

a curvature in a first plane, the first plane extending through the blade and tangent to a cylinder which extends through the blade and is centered along the central axis, the cylinder being of a radius greater than a hub radius and less than the inlet radius; and

no curvature in a second plane, the second plane extending through the blade and tangent to a cylinder which extends through the blade and is centered along the central axis, the cylinder being of a radius greater than the intermediate radius.

2. The centrifugal blower of Claim 1, wherein the leading edges of the blades are substantially perpendicular to the central axis.

3. The centrifugal blower of Claim 1, wherein the trailing edges of the blades are substantially parallel to the central axis.

4. The centrifugal blower of Claim 1, wherein the shroud comprises a first shroud fixed to at least a portion of the respective first side edges of the first plurality of blades for rotation therewith, the first shroud shaped to follow at least a portion of a contour of the respective first side edges of the first plurality of blades.

5. The centrifugal blower of Claim 4, further comprising a second plurality of blades arranged about the central axis, wherein the first shroud is integral with the second plurality of blades, the second plurality of blades having no curvature in a plane extending through the blades and tangent to a cylinder which extends through the blades and is centered along the central axis.

6. The centrifugal blower of Claim 4, wherein the first shroud comprises a cylindrical portion.

7. The centrifugal blower of Claim 6, wherein the cylindrical portion of the first shroud extends upstream of an intersection of the leading edge of the blade and the first side edge of the blade.

8. The centrifugal blower of Claim 1, wherein the shroud is a second shroud integral to at least a portion of the respective second side edges of the first plurality of blades for rotation therewith, the second shroud shaped to follow at least a portion of a contour of the respective second side edges of the first plurality of blades.

9. The centrifugal blower of Claim 8, further comprising a first shroud fixed to at least a portion of the respective first side edges of at least some of the first plurality of blades for rotation therewith, the first shroud shaped to follow at least a portion of a contour of the respective first side edges of the first plurality of blades.

10. The centrifugal blower of Claim 4, further comprising a second shroud fixed to at least a portion of the respective second side edges of at least some of the first plurality of blades for rotation therewith, the second shroud shaped to follow at least a portion of a contour of the respective second side edges of the first plurality of blades.

11. The centrifugal blower of Claim 8, wherein the second shroud is integral with a second plurality of blades, the second plurality of blades having no curvature in a plane extending through the blades and tangent to a cylinder which extends through the blades and is centered along the central axis.

12. The centrifugal blower of Claim 10, further comprising a second plurality of blades, wherein each of the second plurality of blades is integral with the second shroud, and wherein each of the second plurality of blades has no curvature in a plane, the plane extending through the blade and tangent to a cylinder which extends through the blade and is centered along the central axis.

13. The centrifugal blower of Claim 9, further comprising a second plurality of blades, wherein each of the second plurality of blades is integral with the first shroud, and wherein each of the second plurality of blades has no curvature in a plane extending through the blades and tangent to a cylinder which extends through the blades and is centered along the central axis.

14. The centrifugal blower of Claim 10, wherein the second shroud is integral with at least a portion of the respective second side edges of the first plurality of blades.

15. The centrifugal blower of Claim 1, wherein the centrifugal fan is plastic injection molded.

16. The centrifugal blower of Claim 2, wherein the centrifugal fan is plastic injection molded.

17. The centrifugal blower of Claim 4, wherein the centrifugal fan is plastic injection molded.

18. The centrifugal blower of Claim 7, wherein the centrifugal fan is plastic injection molded.

19. The centrifugal blower of Claim 1, wherein each of the blades comprises a skewed leading edge.

20. The centrifugal blower of Claim 2, wherein each of the blades comprises a skewed leading edge.

21. The centrifugal blower of Claim 7, wherein each of the blades comprises a skewed leading edge.

22. The centrifugal blower of Claim 1, wherein each of the blades comprises a raked leading edge.

23. The centrifugal blower of Claim 2, wherein each of the blades comprises a raked leading edge.

24. The centrifugal blower of Claim 7, wherein each of the blades comprises a raked leading edge.

25. The centrifugal blower of any of Claims 1 through 24, further comprising a first non-rotating shroud in a closely-spaced, facing relationship with a portion of the respective first side edges of the plurality of blades and shaped to follow a portion of a contour of the respective first side edges of the plurality of blades, the first non-rotating shroud positioned coaxial with the hub.

26. A centrifugal blower of any of Claims 1 through 24, further comprising a second non-rotating shroud in a closely-spaced, facing relationship with at least a portion of the respective second side edges of the plurality of blades and shaped to follow at least a portion of a contour of the respective second side edges of the plurality of blades, the second non-rotating shroud positioned coaxial with the hub.

27. The centrifugal blower of Claim 25, wherein the first non-rotating shroud has curvature in a plane that contains the central axis.

28. The centrifugal blower of Claim 26, wherein the second non-rotating shroud has curvature in a plane that contains the central axis.

29. The centrifugal blower of Claim 26, further comprising a blower housing substantially enclosing the fan, the blower housing defining an inlet and an outlet; wherein the second non-rotating shroud is fixed to the blower housing.

30. The centrifugal blower of Claim 26, further comprising a blower housing substantially enclosing the fan, the blower housing defining an inlet and an outlet; a motor housing coupled to the blower housing; and a motor supported in the motor housing and comprising a drive shaft drivingly connected to the hub of the centrifugal fan; further comprising a flange at least partially supporting the motor housing on the blower housing, wherein the second non-rotating shroud is integral with the flange.

31. The centrifugal blower of Claim 26, further comprising a blower housing substantially enclosing the fan, the blower housing defining an inlet and an outlet; a motor housing coupled to the blower housing; and a motor supported in the motor housing and comprising a drive shaft drivingly connected to the hub of the centrifugal fan; further comprising:

at least one electrical component operatively connected with the motor; and

a heat sink thermally coupled with the at least one electrical component, the heat sink positioned in the second non-rotating shroud to receive a portion of an airflow generated by the fan to dissipate heat generated by the electrical component.

32. The centrifugal blower of Claim 31, wherein the heat sink is embedded in the second non-rotating shroud substantially flush with the surface in facing relationship with the respective second side edges of the first plurality of blades.

33. A centrifugal blower of Claim 7, further comprising a blower housing substantially enclosing the fan, the blower housing defining an inlet opening, the blower housing comprising a first ring fixed to the blower housing and positioned around the inlet opening of the blower housing, the first ring coaxial with and inside of a cylindrical portion of the first shroud, the first ring at least partially axially overlapping the cylindrical portion of the first shroud, and a second ring fixed to the blower housing and positioned around the inlet opening of the blower housing, the second ring coaxial with and outside of the cylindrical portion of the first shroud, the second ring at least partially axially overlapping the cylindrical portion of the first shroud, a combination of the first ring, second ring, and the cylindrical portion of the first shroud defining a tortuous passageway to substantially restrict airflow discharged from the outlet of the fan from re-entering the inlet of the fan.

34. A centrifugal blower, comprising:

a centrifugal fan comprising

a hub adapted for rotation about a central axis;

a plurality of blades arranged about the central axis and coupled for rotation with the hub, each of the blades defining

a leading edge substantially perpendicular to the central axis;

a trailing edge substantially parallel to the central axis;

a first side edge extending between the leading edge and the trailing edge, the first side edge being swept from the leading edge in a direction axially away from the leading edge and radially outward toward the trailing edge;

a second side edge extending between the leading edge and the trailing edge, the second side edge at least partially integral with the hub, the second side edge being swept from the leading edge in a direction axially away from the leading edge and radially outward toward the trailing edge;

an inlet radius defined as the outermost radius of the blade leading edge;

a first shroud, the first shroud integral with at least a portion of the respective first side edges of the plurality of blades for rotation therewith, the first shroud comprising:

a cylindrical portion coaxial with the hub, the hub and cylindrical portion defining therebetween a substantially annular, axially-oriented inlet of the fan, the cylindrical portion extending upstream of an intersection of the leading edge of the blade and the first side edge of the blade;

a bell portion radially and axially extending from the cylindrical portion, the bell portion at least partially defining a substantially annular, radially outward-oriented outlet of the fan;

an intermediate radius defined as the innermost radius of the first shroud;

a curvature in a plane, the plane extending through the blade and tangent to a cylinder which extends through the blade and is centered along the central axis, the cylinder being of a radius greater than the hub radius and less than the inlet radius;

no curvature in a plane, the plane extending through the blade and tangent to a cylinder which extends through the blade and is centered along the central axis, the cylinder being of a radius greater than the intermediate radius;

a blower housing substantially enclosing the fan, the blower housing defining an inlet opening and a scroll defining an outlet;

a motor supported in the blower housing and comprising a drive shaft drivingly connected to the hub;

at least one electrical component operatively connected with the motor;

a second non-rotating shroud positioned in the blower housing coaxial with the hub, the second non-rotating shroud comprising a surface in closely spaced, facing relationship with the respective second side edges of the plurality of blades and shaped to follow a contour of the respective second side edges of the plurality of blades, the first shroud and second non-rotating shroud at least partially defining therebetween an air passageway between the inlet and outlet of the fan;

a heat sink positioned in the second non-rotating shroud and shaped to conform with the contour of the surface of the second non-rotating shroud, the heat sink thermally coupled with the at least one electrical component;

a first ring fixed to the blower housing and positioned around the inlet opening of the blower housing, the first ring coaxial with and inside of the cylindrical portion of the first shroud, the first ring at least partially axially overlapping the cylindrical portion of the first shroud; and

a second ring fixed to the blower housing and positioned around the inlet opening of the blower housing, the second ring coaxial with and outside of the cylindrical portion of the first shroud, the second ring at least partially axially overlapping the cylindrical portion of the first shroud, a combination of the first ring, second ring, and the cylindrical portion of the first shroud defining a tortuous passageway to substantially restrict airflow discharged from the outlet of the fan from re-entering the inlet of the fan.

35. A method of manufacturing a one-piece fan including a plurality of blades arranged about a central axis and coupled for rotation with a hub, each of the blades defining a low-pressure surface, a high-pressure surface, a leading edge, a trailing edge, and first and second side edges extending between the leading edge and the trailing edge, at least a portion of the hub being integral with at least a portion of the respective second side edges of the plurality of blades and a shroud integral with at least a portion of the respective first side edges of the plurality of blades, the method comprising:

providing a mold divided into a first mold portion and a second mold portion along a parting line, the first mold portion being movable with respect to the second mold portion along a mold axis;

molding a first portion of the respective low-pressure surfaces of the blades in the first mold portion;

molding a second portion of the respective low-pressure surfaces of the blades in the second mold portion; and

joining the first and second portions of the respective low-pressure surfaces of the blades along a portion of the parting line oriented between about 1 degree and about 90 degrees from the mold axis.

36. The method of Claim 35, wherein joining the first and second portions of the respective low-pressure surfaces of the blades occurs along a portion of the parting line oriented between about 45 degrees and about 90 degrees from the mold axis.